

93. Jan. 1994

## (12) UK Patent Application (19) GB (11) 2 267 474 (13) A

(43) Date of A publication 08.12.1993

(21) Application No 9311229.0

(22) Date of filing 01.06.1993

(30) Priority data

(31) 4218266

(32) 03.06.1992

(33) DE

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B65G 29/00, A24C 5/60

(52) UK CL (Edition L)

B8A A8DA A801 A850

A2C CGS

U1S S1114

(56) Documents cited

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GB 1152250 A

US 4565202 A

(58) Field of search

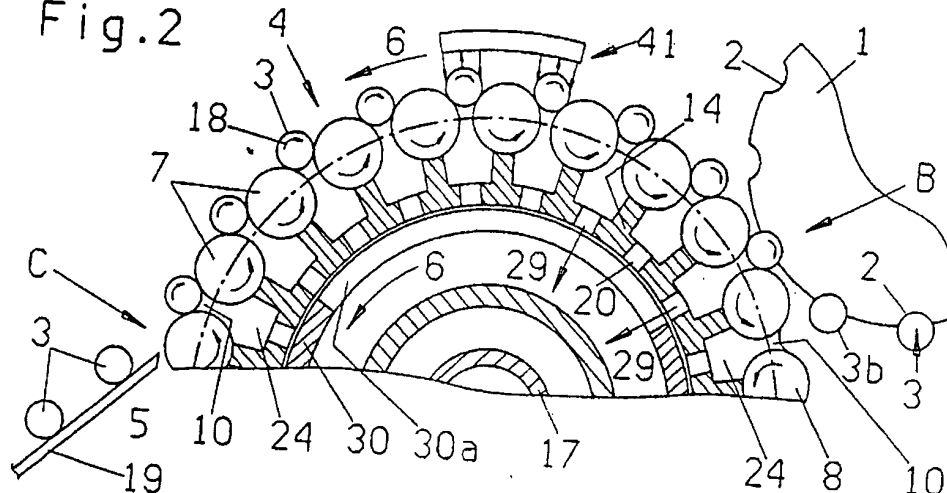
UK CL (Edition L) B8A A8DA A8DC A8H A8K A8M  
A8R A81INT CL<sup>8</sup> A24C 5/18 5/32 5/34 5/60, B65G 29/00  
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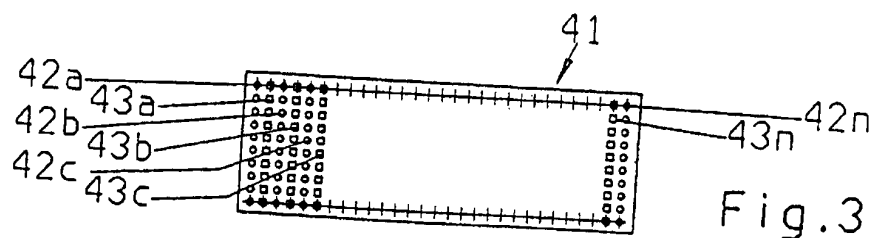
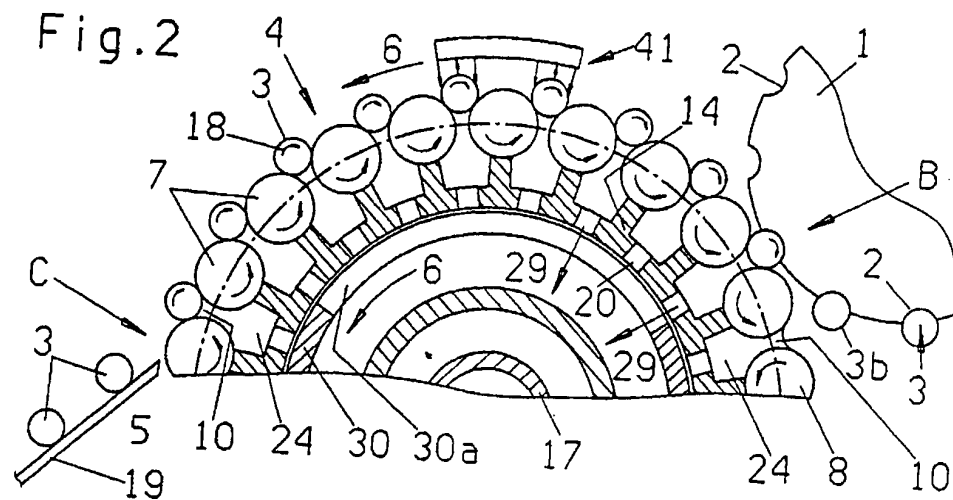
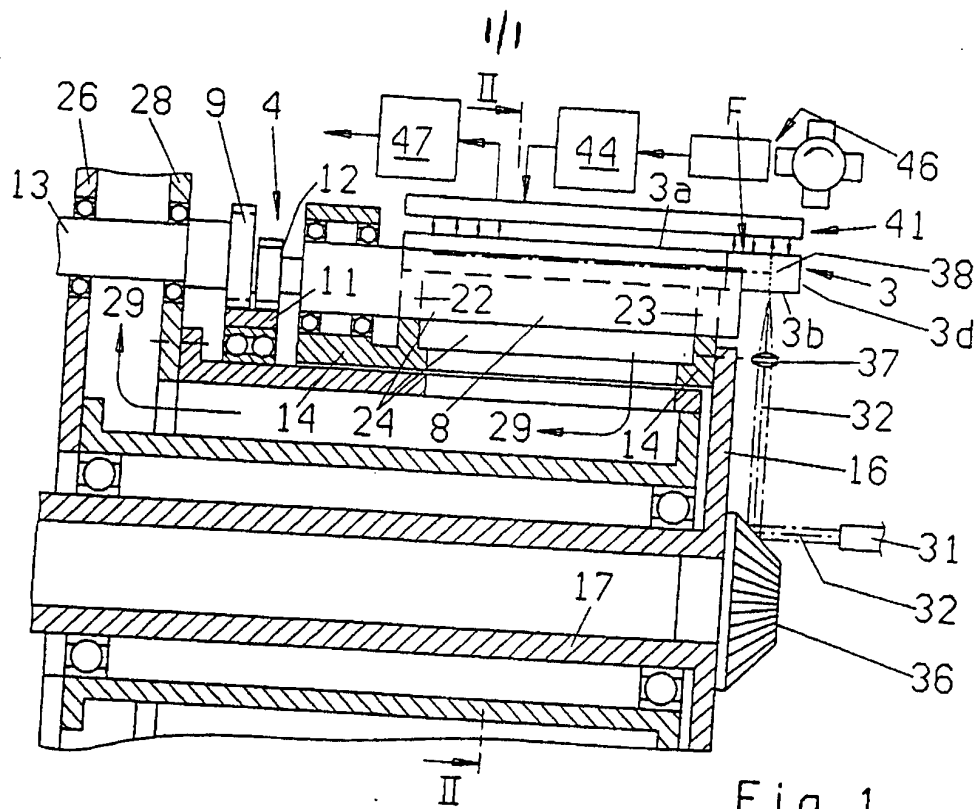
Online databases: WPI

(54) Apparatus for circulating and rotating rod-shaped articles

(57) Cigarettes 3 are tested and/or perforated while advancing along a circular path at the periphery of a rotary drum 4 in receptacles each of which has two parallel driven rollers 7 contacting the external surface of the cigarette in the respective receptacle. The cigarettes are attracted to the rollers by suction. A laser (31, Fig 1 not shown) can be provided to emit one or more beams which are used to perforate the wrappers of the cigarettes while the cigarettes rotate about their own axes as a result of rotation of the respective rollers and while the cigarettes simultaneously advance with the drum. Rows of alternating light-emitting diodes 41 and photoelectric diodes can be used to monitor the external surfaces of the cigarettes in their receptacles.

Fig.2





-1-

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APPARATUS FOR CIRCULATING AND ROTATINGROD-SHAPED ARTICLES

The invention relates to improvements in apparatus for transporting elongated articles which have substantially cylindrical external surfaces. Typical examples of articles which can be transported in the apparatus of the present invention are rod-shaped articles of the tobacco processing industry; such articles include plain or filter cigarettes, cigars and cigarillos, cheroots and filter rod sections of unit length or multiple unit length.

U.S. Pats. Nos. 2,809,640 and 3,036,581 disclose apparatus wherein cigarettes and filter rod sections are transported at the periphery of a rotary drum-shaped conveyor and are rotated about their respective axes by driven rollers which are adjacent the cigarettes on the conveyor. The purpose of such transport of cigarettes and filter rod sections is to convolute an adhesive-coated uniting band around one end portion of each cigarette and around the adjacent filter rod section and to thus convert such parts into a filter cigarette.

Commonly owned U.S. Pat. No. 4,281,670, granted August 4, 1981 to Uwe Heitmann et al. for "Apparatus for increasing the permeability of wrapping material for rod-shaped 'smokers' products", discloses an apparatus which is used to rotate cigarettes on a driven drum-shaped conveyor by means of a roller which is driven in the opposite direction. The arrangement can be such that successive cigarettes come to a temporary halt (i.e., they no longer advance with the drum-shaped conveyor) while rotating about their own axes. A cigarette which rotates about its own axis but is caused to temporarily interrupt its movement with the drum-shaped conveyor is acted upon by radiation, such as by one or more laser beams, in order to provide one or more portions of its wrapper with perforations. The perforations are believed to be

-2-

desirable and advantageous because they permit cool atmospheric air to penetrate into the column of hot tobacco smoke flowing from the lighted end of the article toward the mouth of a smoker. The perforations can be provided in the wrapper of the filter mouthpiece forming part of a filter cigarette. The apparatus of Heitmann et al. operates quite satisfactorily as long as the cigarettes are transported below a predetermined speed. Such speed may not be sufficient when the cigarettes issue from a modern cigarette rod making machine which can turn out well in excess of 10,000 cigarettes per minute.

-3-

The invention is embodied in an apparatus for transporting elongated articles each of which has an axis and a substantially cylindrical external surface surrounding the respective axis. The improved apparatus comprises a circulating conveyor (such as a rotary drum), and a plurality of receptacles for the articles. The receptacles are provided on the conveyor and each such receptacle comprises a plurality of driven rotary members which contact the external surface of the article in the respective receptacle to rotate the article about its own axis while the article circulates with the conveyor. The apparatus further comprises means for pneumatically holding the articles in the receptacles. If the articles are rod-shaped articles (such as cigarettes) of the tobacco processing industry, the external surfaces are the exposed sides of tubular wrappers of such rod-shaped articles.

The holding means can include means for attracting the articles to the respective rotary members by suction.

The rotary members can constitute parallel rollers, and each receptacle can comprise two rollers. The arrangement is preferably such that the axes of the rollers are parallel to the axes of the articles and to the axis of rotation of the conveyor if the conveyor is a rotary drum. Such apparatus further comprises means for rotating all of the rollers in a single predetermined direction.

If the articles have tubular wrappers, the apparatus can further comprise means for perforating the wrappers of articles in the receptacles. Such perforating means can comprise at least one source of radiation (e.g., a laser) and means for focusing radiation upon the wrappers of articles in the receptacles. The focusing

-4-

means can include means for moving radiation with the articles in the receptacles while the receptacles circulate with the conveyor.

Still further, the apparatus can comprise means for monitoring the external surfaces of articles in the receptacles, e.g., for monitoring the external surfaces of the wrappers for the presence of holes, open seams, frayed ends, smudges and/or other defects. The monitoring means can include at least one source of radiation and means for directing radiation from the source against the external surfaces of articles in the receptacles. For example, the monitoring means can comprise at least one light source, and such at least one source can include at least one array of light-emitting diodes cooperating with at least one array of photoelectronic diodes. For example, the light-emitting diodes can form two or more rows and the photoelectronic diodes can form two or more rows which alternate with the rows of light-emitting diodes.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain presently preferred specific embodiments with reference to the accompanying drawings.

-5-

FIG. 1 is a fragmentary axial sectional view of an apparatus which embodies one form of the invention;

FIG. 2 is a fragmentary transverse sectional view substantially as seen in the direction of arrows from the line II-II in FIG. 1; and

FIG. 3 is an enlarged schematic view of a detail in the article monitoring means of the apparatus which is shown in FIGS. 1 and 2.

-6-

The apparatus which is shown in FIGS. 1 and 2 comprises a rotary drum-shaped conveyor 4 having equidistant axially parallel receptacles 7 for discrete rod-shaped articles 3. Each article 3 is assumed to constitute a filter cigarette of unit length or multiple unit length which has a central longitudinal axis 3a and a tubular wrapper having a peripheral or external surface 3b which spacedly surrounds the respective axis 3a. The means for supplying articles 3 into successive receptacles 7 at a first transfer station B comprises a second rotary drum-shaped conveyor 1 which is driven in a clockwise direction (as viewed in FIG. 2) and has axially parallel peripheral flutes 2 for discrete articles 3. The articles 3 are attracted by suction to the surfaces bounding the respective flutes 2 in a manner well known from the art of making and manipulating rod-shaped articles of the tobacco processing industry. Reference may be had to the disclosure of the aforementioned commonly owned patent to Heitmann et al. The disclosure of Heitmann et al., as well as of each other U.S. patent mentioned in this specification, is incorporated herein by reference. Suction is interrupted at the transfer station B so that an article 3 which is being transported by the conveyor 1 can be readily transferred into the adjacent (oncoming) receptacle 7 of the conveyor 4.

The conveyor 4 is driven by its hollow shaft 17 so that it rotates in the direction of arrow 6; such circulatory movement is shared by the receptacles 7. The receptacles 7 retain the articles 3 by suction during advancement from the first transfer station B to a second transfer station C where the articles are no longer attracted by suction so that they leave the respective receptacles 7 and advance to a further processing station, not shown, e.g., by rolling along a ramp 19.



-7-

Each receptacle 7 comprises two driven rotary members 8 in the form of elongated rollers which are parallel to each other as well as to the axes of the hollow shaft 17 and conveyor 1. Two neighboring receptacles 7 share a roller 8, namely the roller which is located between them. The rollers 8 are driven (to rotate in the direction indicated by the arrows 5) by a transmission including a driven shaft 13 journaled in a stationary support 28, a first gear 9 on the shaft 13, a ring gear 11 on the conveyor 4, and a pinion 12 on each roller 8. The pinions 12 mate with the ring gear 11, and the latter mates with the gear 9. Other suitable means for rotating all of the rollers 8 in the same direction (arrows 5) can be used with equal or similar advantage.

The rollers 8 are journaled in a sleeve-like bearing member 14. The latter is affixed to a disc 16 on the shaft 17. The means for rotating the shaft 17 (and hence the conveyor 4) in the direction of arrow 6 can comprise a variable-speed electric motor (not shown) or any other suitable prime mover.

When the apparatus is in actual use, the shaft 17 drives the conveyor 4 in the direction of arrow 6, and the conveyor 4 causes the receptacles 7 to orbit about the axis of the shaft 17 in the same direction. At the same time, the shaft 13 causes the rollers 8 to rotate in the directions indicated by arrows 5 so that the articles 3 between the transfer stations B and C rotate about their own axes 3a as indicated by the arrows 18. This results in continuous advancement of a file of parallel articles 3 from the flutes 2 of the conveyor 1, in the receptacles 7 of the conveyor 4, along the ramp 19 and on to a further station, e.g., by means of an endless belt or chain conveyor having an upper reach positioned to receive successive articles 3 from the ramp 19.

The means for pneumatically holding the articles

-8-

3 in the respective receptacles 7 (i.e., for attracting the articles to the respective pairs of rollers 8) during advancement from the transfer station B to the transfer station C comprises suction chambers 24 having intakes 10 between the pairs of rollers 8, suction ports 20 in the conveyor 4, and a ring-shaped valving element 30 having a slot 30a for the flow of air from the ports 20 to the intake of a fan or any other suitable suction generating device, not shown. The suction chambers 24 extend between two walls 22, 23 at the axial ends of the conveyor 4. The flow of air from the suction chambers 24 to the intake of the suction generating device is indicated by arrows 29. The aforementioned stationary support 28 can be said to form part of the suction generating device; this support defines a duct 26 which receives air flowing through the slot 30a of the valving element 30.

The apparatus further comprises means for providing the articles 3 (and more particularly the tubular wrappers of such articles) with suitably distributed annuli and/or other formations of perforations 38. The perforating means includes a radiation source 31 (e.g., a laser) which discharges at least one pulsed energy-rich beam 32 of coherent radiation against a focusing system including a conical prism 36 having a plurality of facets and being connected to the conveyor 4. The facets constitute mirrors which direct beams of radiation against a lens 37 which, in turn, focuses such radiation upon the end portions 3d of successive articles 3 in the respective receptacles 7. FIG. 1 shows that the beam 32 of coherent radiation provides each article 3 with an annulus of perforations 38; such perforations permit atmospheric air to enter the column of tobacco smoke when a filter cigarette or another smokers' product is lightened. The formation of annuli of perforations 38 is due to the fact that the articles 3 rotate about their

- 9 -

respective axes 3a while advancing with the conveyor 4 about the axis of the shaft 17. If the articles 3 are filter cigarettes, the annuli of perforations 38 are preferably provided in the tubular wrappers of their filter mouthpieces F.

The focusing means of the perforating unit can be constructed in such a way that the single beam 32 issuing from the radiation source 31 is broken up into two or more beams and each such discrete beam is directed upon a discrete article 3 while the latter rotates in its receptacle 7 as a result of rotation of the respective rollers 8 about their own axes.

The exact construction of the focusing means forms no part of the present invention. Reference may be had, for example, to U.S. Pat. No. 4,720,619 granted January 19, 1988 to Riccardo Mattei et al. for "Device for piercing holes in rod-shaped items", to U.S. Pat. No. 4,633,891 granted January 6, 1987 to Riccardo Mattei et al., for "Piercing device for piercing ventilating holes in cigarettes or similar smoking commodities", to U.S. Pat. No. 4,660,578 granted April 28, 1987 to Riccardo Mattei et al. for "Piercing device for piercing ventilating holes in cigarettes or similar smoking commodities", to U.S. Pat. No. 5,015,819, and to U.S. Pat. No. 4,565,202 granted January 21, 1986 to Enzo Seragnoli et al. for "Method and apparatus for forming perforation in bar-shape articles".

In lieu of or in addition to a laser-operated or other suitable perforating unit, the improved apparatus can be used to transport rod-shaped articles past a monitoring unit 41 which can be designed to ascertain the presence or absence of defects in the wrappers of rod-shaped articles. As shown in Figs. 1 and 2 the illustrated conveyor 4 is positioned to transport

-10-

successive articles 3 past a stationary radiation source having light-emitting diodes 42a ... 42n (FIG. 3) serving to emit beams of radiation which is used to optically scan the condition of wrappers on successive articles 3. The wrappers can be made of cigarette paper, of so-called tipping paper or of any other suitable wrapping material which can be used to confine rod-shaped fillers of tobacco, to confine rod-shaped filter material for tobacco smoke or to attach filter mouthpieces to plain cigarettes, cigars or cigarillos of unit length or multiple unit length. As can be seen in FIG. 3, the monitoring unit 41 can include a number of rows or similar arrays of light-emitting diodes 42a ... 42n which alternate with arrays (rows) of photoelectronic diodes 43a ... 43n or with connectors leading to terminals of optical fibers, not shown. The diodes 42a ... 42n emit light which impinges upon selected portions of wrappers of the articles 3 advancing with the conveyor 4. The reflected radiation impinges upon the photosensitive portions of photoelectronic elements 43a ... 43n which generate signals ready to be processed into signals denoting the condition of monitored wrappers. If the signals are indicative of defective wrappers, the corresponding articles are segregated from satisfactory articles by pneumatic or other suitable ejector means, for example, in a manner known for many decades from the art of cigarette testing. For example, the nature of radiation issuing from the diodes 42a ... 42n and reflected by tobacco particles or particles of filter material for tobacco smoke in holes or within open seams of wrappers is different from the nature of radiation which issues from the diodes 42a ... 42n and is reflected by satisfactory portions of wrappers forming part of successively tested articles 3. Analogously, signals which are generated by the diodes 43a ... 43n in response to detection of

-11-

radiation which is reflected by fragments of tobacco particles adhering to external surfaces 3b of the articles 3 and/or by smudges on the external surfaces 3b of such articles can be processed into signals denoting defective wrappers and rendering it possible to segregate defective articles from satisfactory articles not later than upon arrival at the packing or storing location. Classification of signals which are transmitted by the diodes 43a ... 43n into signals denoting satisfactory and unsatisfactory articles 3 can involve comparison of such signals with reference signals.

The utilization of entire arrays of diodes 42a ... 42n and 43a ... 43n is desirable and advantageous in order to ensure accurate testing of any desired portion of a tubular wrapper. The articles 3 move in the direction of arrow 6 and simultaneously rotate about their own axes 3a (arrows 18) during transport between the transfer stations B and C, i.e., during advancement past the radiation sources in the monitoring unit 41. Reliable testing necessitates activation of various diodes 43a ... 43n during different stages of scanning of a wrapper which advances past the unit 41. Such activation is effected by a control circuit 44 which receives impulses from a position sensor 46 to activate the arrays of diodes 43a ... 43n during appropriate stages of illumination of the wrapper of an article 3 advancing through the wrapper testing station. The outputs of the diodes 43a ... 43n are connected to the corresponding inputs of an evaluating circuit 47 which transmits a "defect" signal in response to reception of one or more signals (from the photoelectronic diodes) denoting that the tested wrapper contains one or more flaws including one or more frayed ends, open seams, holes, rips, smudges and/or others which warrant segregation of the corresponding article 3 from satisfactory or acceptable articles.

-12-

The distribution of diodes 42a ... 42n and 43a ... 43n can be such that the testing of a preceding article is completed or is about to be completed when the immediately following article enters the optical testing station.

The illustrated monitoring unit including the radiation sources 42a ... 42n and the diodes 43a ... 43n can be replaced with other suitable testing systems without departing from the spirit of the invention. For example, the illustrated arrays of diodes 42a ... 42n and 43a ... 43n can be replaced with a camera having means for scanning with an electron beam. Analogously, the laser 31 can be replaced with another suitable source of radiation.

An important advantage of the improved apparatus is that it can transport rod-shaped articles at an elevated speed and that the articles can be rotated about their own axes in a highly predictable manner. Thus, the articles 3 can turn about their respective axes 3a at a high speed during high-speed transport along the arcuate path extending from the transfer station B to the transfer station C. Furthermore, the apparatus is simple and compact so that it occupies little room in or adjacent a filter tipping or like machine.

-13-

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the appended claims.

-14-

CLAIMS:

1. Apparatus for transporting elongated articles each having an axis and a substantially cylindrical external surface surrounding the respective axis, comprising a circulating conveyor; a plurality of receptacles for articles, said receptacles being provided on said conveyor and each having a plurality of driven rotary members contacting the external surface of the article in the respective receptacle to rotate the article about the corresponding axis while the article circulates with the conveyor; and means for pneumatically holding the articles in said receptacles.



-15-

2. The apparatus of claim 1, wherein said conveyor comprises a rotary drum and the articles are rod-shaped products of the tobacco processing industry.

3. The apparatus of claim 1, wherein said holding means includes means for attracting the articles to the respective rotary members by suction.

4. The apparatus of claim 1, wherein said rotary members are parallel rollers and each of said receptacles comprises two rollers.

-16-

5. The apparatus of claim 4, further comprising means for rotating all of said rollers in a single predetermined direction.

6. The apparatus of claim 1 for transporting articles of the type having tubular wrappers with the external surfaces provided on the respective wrappers, further comprising means for perforating the wrappers of articles in said receptacles, said perforating means including at least one source of radiation and means for focusing radiation upon the wrappers of articles in said receptacles.

7. The apparatus of claim 6, wherein said focusing means includes means for moving radiation with the articles in the receptacles while the receptacles circulate with said conveyor.

-17-

8. The apparatus of claim 6, wherein said at least one source includes a laser.

9. The apparatus of claim 1, further comprising means for monitoring the external surfaces of articles in said receptacles, including at least one source of radiation and means for directing radiation from said at least one source against the external surfaces of articles in said receptacles.

10. The apparatus of claim 9, wherein said monitoring means comprises at least one light source.

-18-

11. The apparatus of claim 9, wherein said at least one source includes at least one array of light-emitting diodes and said monitoring means further comprises at least one array of photoelectronic diodes.

12. The apparatus of claim 11, wherein said at least one source includes a plurality of rows of light-emitting diodes and said photoelectronic diodes form a plurality of rows alternating with said rows of light-emitting diodes.

13. Apparatus for transporting elongated articles substantially as herein described with reference to the accompanying drawings.

Patents Act 1977

Examiner's report to the Comptroller under  
Section 17 (The Search Report)

Application number

GB 9311229.0

## Relevant Technical fields

- (i) UK CI (Edition L ) B8A (A81, A8DA, A8DC, A8H,  
A8K, A8M, A8R)
- (ii) Int CI (Edition 5 ) B65G (29/00, 29/02, 47/91)  
A24C (5/18, 5/32, 5/34, 5/60)

Search Examiner

S WALLER

## Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

6 JULY 1993

Documents considered relevant following a search in respect of claims 1 TO 13

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2141542 A (KORBER KG) see page 4 line 100 to page 5 line 62, page 9 lines 56 to 87	9-11
X Y	GB 1152250 (METAL BOX) see whole document	1-5, 6-8, 9-11
Y	US 4565202 (G D SOCIETA' PER AZIONI) see whole document	6-8

Category	Identity of document and relevant passages	Relevant to claim(s)

**Categories of documents**

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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